Field of Invention

This invention relates generally to the field of information acquisition and display devices on a real-time basis and more particularly to systems which monitor the operation of powered vehicles and which display the status or condition of various aspects of vehicle operation for the driver. The invention specifically relates to the display of systems involving the anti-lock braking system, the stability of the vehicle as to proximity to rolling over, the power consumed by vehicle components such as the heating system and lights and/or, for four-wheel drive vehicles, the torque and/or braking forces delivered to the wheels. The information is acquired from sensors and/or from signals generated by the vehicle and is processed by the vehicle CPU or, in another embodiment by a display CPU. The processed information is then displayed for the driver in black and white or in color using an LED, LCD, vacuum fluorescent means, numerical display, gauge or meter.

Background of the Invention

No prior art can be found which discloses the present invention. Historically the status of drive train components, of anti-locking brake system components, power usage by vehicle components, and/or of the approach of a rollover condition have not been displayed for the driver by any type of vehicle.

US Patent 6,398,688, by Brown, et al, however discloses a visual display in Figure 1 but without elaboration in the specification.

US Patent number 6,497,301 by Iida, et al, discloses an indicator 25 and alarming lamp and alarm 26 in Figure 1 without further elaboration in the specification. Regarding the same type of disclosure, reference is made to US Patent number 6,493,623 Nishida, et al.

US Patent number 46,603,393 by Sumada, et al, discloses a display for a vehicle operator for functional status of the vehicle but only mentions an open hood latch. No mention is made of the dynamics of operation of the vehicle.

US Patent number 5,825, 284, Dunwoody et al, discloses a system and method of calculating the approach of a rollover condition for a vehicle. The method described uses a "lateral load transfer" sensor to calculate the center of gravity which is an inoperable means to make this calculation. Restated, very low weight loadings on a vehicle can be configured which will give high lateral loading and which result in no turning moment whatever. The Dunwoody patent is completely inoperable. The present invention uses a harmonic frequency sensor which provides the means to calculate the center of gravity of a vehicle with great accuracy. With this and the input from a lateral acceleration sensor, the approach to a rollover condition of a vehicle is calculated with great accuracy.

US Patent number 5,949,330, Hoffman et al, discloses a general monitoring and diagnosing means without reference to monitoring vehicle parameters and without reference to the approach of a rollover condition of a vehicle.

US Pat number 6,721, 634, Hauler, et al, discloses the use of a "freely programmable instrument cluster" within a vehicle but does not recite any vehicle parameters which are to be monitored and displayed. No reference is made regard monitoring vehicle parameters which would indicate the approach of a rollover condition of a vehicle.

US Patent number 5,555,502, Opel, discloses a control system and an associated method with feedback input by the driver of a vehicle but does not recite any vehicle parameters which are to be monitored and displayed. No reference is made regard monitoring vehicle parameters which would indicate the approach of a rollover condition of a vehicle.

US patent number 5,880,710, Jabei, et al, utilizes a filtering and selection means for information but does not recite any vehicle parameters which are to be monitored and displayed. No reference is made regard monitoring vehicle parameters which would indicate the approach of a rollover condition of a vehicle.

US patent number 4,594,572, Haubner, et al, discloses a complex display means and primarily addresses the processing of information. The sole example given of a condition to be monitored is that of an open trunk compartment. Otherwise it does not recite any vehicle parameters which are to be monitored and displayed. No reference is made regarding the monitoring of vehicle parameters which would indicate the approach of a rollover condition of a vehicle.

US patent number 5,949,345, Berkert, et al, discloses a system based upon a computer program without the utilization of a dedicated display. The sole vehicle parameter mentioned which is to be monitored is the fuel gauge. Torque related information, as delivered to the wheels and the approach to a rollover condition by a vehicle are not mentioned.

The present invention discloses the use of a dynamic or real time display of the relative amounts of torque being transferred to the axles of a four-wheel drive vehicle and the use of an accurate monitoring means to indicate the approach of a rollover condition of a vehicle. These types of displays are currently unavailable to vehicle operators. No patents, including those cited above, disclose the method, system, process or apparatus of the present invention.

Summary of the Invention

The present invention is an apparatus, method, process and system for displaying real-time operational information about a motor vehicle to the driver. The invention specifically relates to the display of the status of systems involving the anti-lock braking system, the stability of the vehicle as to the approach of a rollover condition, the power consumed by vehicle components such as the heating system and lights and the torque and/or braking forces delivered to the wheels. The information is acquired from sensors and/or from signals generated by the vehicle and is processed by the vehicle CPU or, in another embodiment, by a display CPU. The processed information is then displayed for the driver in black and white or in color using an LED, LCD, vacuum fluorescent means, numerical display, gauge or meter.

The preferred images used in said display to convey said operating parameters are meaningful, symbolic, easily understood and spare in style. The presentation is in either black and white or color and the variety of types of display devices enumerated all generally serve to adequately display the needed information. Audible signals and/or warnings are used to augment these visual presentations. The preferred displays are time-variant, concise and appropriate for the information presented and include a proportional symbolic display, bar charts, a segmented bar chart, variable-size or variable-shape icon or images.

It is an object of the present invention to provide an improved display means and system for the display of vehicle operating parameters to an operator of a motor vehicle.

It is another object of the present invention to display information regarding the distribution of torque or driving forces at the wheels of a vehicle to the operator of the vehicle.

It is another object of the present invention to display information to the operator regarding the approach of a rollover condition of the vehicle.

It is another object of the present invention to collection information for display to an operator regarding the driving forces at the wheels of a vehicle by using a flux sensor or Hall effect sensor.

It is another object of the present invention to display to the operator of a vehicle, information regarding the usage of power by various power consuming components of the vehicle.

As disclosed by the present invention, the following items are new, useful applications of existing technologies for the display of information regarding the performance of a vehicle to the operator of the vehicle:

(1) the torque or driving forces being delivered to the wheels;

(2) the slippage of one or more wheels relative to the other wheels, particularly for four wheel drive vehicles;

(3) the accurate visual display of the approach of a rollover condition of the vehicle;

(4) the power being used by the power consuming components of a vehicle;

(5) the use of true audible warnings for the approach of a rollover condition of a vehicle.

These applications are not obvious as the required technologies are old and the need for these applications has been long standing. Until the present invention, they have been unavailable.

These and other objects an advantages of the present invention will become clear to those skilled in the art in view of the description of the best presently known mode of carrying out the invention and the applicability of the preferred embodiment as described herein and as illustrated in the several figures of the drawings.

Brief Description of the Drawings

Figure 1 is a display of a scalar bar diagram image of the braking force on the two rear wheels.

Figure 2 is a display of four wheel images representing the amplitude of the braking force on each wheel and the turning angle of the front wheels.

Figures 3 and 4 are displays of wheel images indicating the amplitude of the braking force on each wheel.

Figure 5A is a display of four wheel images representing the amplitude of the braking force on each wheel.

Figures 5B and 5C are displays of wheel images representing the amplitude of the relative amount of torque delivered to each of four wheels.

Figures 6A, 6B, 7A and 7B are each a display of a wheel image indicating the amplitude of the torque delivered to a wheel.

Figures 8A, 8B and 9 are each a diagram of a system schematically showing component monitoring, data processing means and an image display.

Figure 10A schematically illustrates an in-line connector.

Figure 10B schematically illustrates an in-line connector and an inserted coil.

Figures 10C and 10D illustrate a clamping induction coil.

Figure 10E schematically illustrates an in-line current sensing device.

Figures 11A and 11B are each a schematic diagram of an ABS system monitoring, data processing means and an image display.

Figures 12A and 12B are each a schematic diagram of an accelerometer and harmonic frequency sensor, data processing means and an image display.

Figure 13 is a display of a torque distribution image.

Figure 14 schematically illustrates placement of a wheel load sensor.

Figure 15 illustrates a display of torque and braking representations for four wheels.

Figure 16 illustrates a display of torque, braking and steering representations for the wheels of a four wheel vehicle.

Figures 17A and 17B each illustrate a display of symbols and/or numerals, each representing the power consumption of a system component.

Figures 17C and 17D each illustrate a bar chart pie segment display of images of power consuming components of a system.

Figures 18A and 18B are each a schematic diagram of power component monitoring, data processing means and an image display.

Figures 19A and 19B each illustrate a display indicating the approach to a rollover condition.

Figure 20 is a flow chart illustrating functional processing of information by a display CPU and system.

Reference Numerals - Description

Numeral	Description
1.	Left front tire
2.	Right front tire
3.	Left rear tire
4.	Right rear tire
5.	Front transfer case
6.	Rear transfer case
7.	Front axle
8.	Rear axle
9.	Front-rear transfer shaft
10.	Braking indicator line
11.	General reference number for a display
12.	Upper display bar
13.	Lower display bar
14.	Power source
15.	In-gear braking indicator
16.	Highlighted item
17.	Band, moving traction indicator
18.	Vehicle outline
19.	Harmonic frequency sensor
20.	High temperature tape
21.	Arc indicator
22.	Wheel steering angle sensor
23.	Wheel steering angle sensor connector
24.	Electromagnetic clutch
25.	Winch symbol
26.	In-line connector
27.	Toroidal coil sensor
28.	Master brake cylinder and controller
29.	Brake
30.	Display device, mounted
31.	Brake line
32.	CPU, vehicle
33.	Power takeoff symbol
34.	Electromagnetic clutch controller
35.	Flux sensor
36.	CPU, display system
37.	Accelerometer or gravity direction sensor
38.	Bar chart amplitude
39.	CPU connector
40.	Negative bar chart amplitude

Numeral	Description
41.	Bar chart, left front wheel
42.	Bar chart, right front wheel
43.	Bar chart, left rear wheel
44.	Bar chart, right rear wheel
45.	Wheel speed sensor
46.	Wheel speed connector
47.	Connector, vehicle CPU
48.	ABS controller
49.	Bar chart
50.	Connector to vehicle CPU
51.	Connector to display CPU
52.	Scalar bar diagram
53.	Indicator bar
54.	Clamping induction coil
55.	Sound amplitude indication symbol
56.	Bar chart divider
57.	Analog to digital (A/D) converter
58.	Wheel load sensor
59.	Direction arrow
60.	Vehicle lighting symbol
61.	Net acceleration vector
62.	Center of gravity of vehicle
63.	--
64.	Ground
65.	Stereo system (speaker) symbol
66.	Air conditioning system symbol
67.	Cruise control symbol
68.	Heating system symbol
69.	Bar chart
70.	Power sensor
71.	Numerical display
72.	Scalar module
73.	Vector angle
74.	Radial line
75.	Vehicle display panel
76.	Reference image data module
77.	General reference number for a variable image
78.	Bar chart in pie segment format
79.	Device formating module
80.	Numerical display
81.	Image generation module

Numeral	Description
82.	--
83.	In-line series current sensor
84.	Alarm speaker
85.	Alarm speaker connector